Professional Career of Women Graduates in Computing in Costa Rica: a Generational Study

Marta Calderón, Gabriela Marín, Gustavo López
University of Costa Rica
San José, Costa Rica
{marta.calderon, gabriela.marin, gustavo.lopez_h}@ucr.ac.cr

***Abstract*— The evolution in women´s professional career in computing has been studied very little. In a previous study (LAWWCC 2016) we reported results of an exploratory study that aimed to characterize the professional development model of people that studied Computer Sciences in Costa Rica, in terms of roles and industrial sectors with which they began their professional career and in which they report are currently working.. Surprisingly, no important gender differences were depicted amongst men and women. As a result, some valid concerns were raised regarding the question: do the results represent the behavior of women in all professional career stages? As a result, in this study, results are now grouped by generations. The aim of this study is to determine whether there are differences in these variables in the professional career evolution for different generations. Results are obtained from an online survey responded by 166 women professionals in Computer Sciences. Women are grouped in four generational categories: baby boomers, generation X, young and mature millennials. The main finding of this research is that the professional evolution of women, with respect to the role and sector in which they perform, revel different behaviors for women of different generations.**

Keywords — professional career; women; generations

I. INTRODUCTION

The professionalization of Computer and Information Technology in Costa Rica began a little over forty years ago. Since then, thousands of professionals have been integrated into the labor market and have been working in very diverse jobs, adjusting their working roles to the needs of society and changes in technology. However, there is very little information available on how professionals develop in this field and what their contribution to society is.

The Chamber of Information and Communication Technologies (CAMTIC) carried a study focusing on the market needs of professionals in the Costa Rican labor market and not on the professional career of our computer scientists [1]. Studies carried by the National Council of Rectors (CONARE) and universities, for example [2], aim to evaluate employability (i.e., potential of graduates to enter and remain in the labor market and their satisfaction level). These studies do not delve into the migration of professionals between industry sectors or in gender aspects. Moreover, these studies do not contemplate the long-term trajectory of professionals.

In [3], the professional development model of men and women who studied Computer Sciences or Informatics in Costa Rica, in terms of types of work with which they begin their professional career and in which they report are currently working is reported. Its main finding is that male and female professional evolutions are similar, that means no significant gender differences were found. However, differences among generations were not studied. Professional career migrations were reported totalized for women and for men.

Models of professional development are useful both to generate theoretical knowledge as well as to produce some knowledge to allow universities and industry to attract and retain the talent to the area. This is very important for the information and telecommunication technology (ICT) industry which always complains employee offer is shorter than employer demand. In particular, we feel that in depth studies regarding female professional careers in the area can help devise ways of attracting and retaining women in the ICT labor market.

In this study we try to determine whether there are differences in the female professional career evolution for different generations. A generation is an identifiable group of people that shares birth years (hence age) and are defined by significant life events at critical developmental stages [4]. Members of a generation share certain thoughts, values, and behaviors because of these shared events. Furthermore, values, reactions, and behaviors presumably differ across different generations [4]. Literature, based mainly in US and global events, has defined some generations which are have been accepted at least in the Occidental culture.

Generations are defined by determinant events with affect the whole population. However, some specific ICT events may impact ICT professional careers as well. In this study we try to incorporate both types of events to group Costa Rican ICT female professionals in four different categories. Emigration and immigration to industrial sectors and among professional roles are described for these four generational groups.

II. RELATED WORK

In this section some effort is given to define and typify what professional careers are. Also, generations and defined and categorized. Finally, studies about the Costa Rican ICT work market are summarized.

A. Professional career

According to [5], the expression professional career relates to different stages a person goes through after finishing her/his college education or getting into the work market. The professional career comprises not only the tasks and responsibilities associated to the job, but also social and economic aspects.

In [6], three career stages are mentioned: entry, middle, and ending. The entry stage refers to the first job. This is a socialization period in which tasks executed in job positions are technical and specific and people get used to the organization technology. During the entry stage, worker´s superiors may identify employer´s potential. In the middle career, job positions have a wider scope and more depth, which means that tasks are less technical and specific. Development of social skills and technical competencies becomes more important in the middle stage. Finally, in the ending stage the person has reached a high degree of specialization in technical or managerial skills and competencies.

In the Engineering field, in which Computer Science is included, the professional career of a person may take one of two paths: the technical and the managerial [6]. The path to follow will depend on skills and competencies that each person is able to develop, opportunities that employers offer, and decisions the person makes about her/his professional career.

According to [7], professionals in Computer Science start working on technical positions, move to project technical management, and finally shift to predominantly managerial jobs. As a person moves through this path, she/he gains and improves managerial skills and loses the technical ones. In [8], a gender study, authors concluded that technical and managerial competencies are mutually exclusive.

In [9], a third career path is introduced: the protean. This means that professionals in Computer Science and Information Technology "move from an IT job to a non-IT job in their career path [9]."

B. Generations

Currently, in companies and institutions, three worker generations coexist: baby boomers, generation X and generation Y. Members of the generation X are known as X-ers. The generation Y is also known as millennials. There is not only one date of birth range definition for each of these generations [4]. Moreover, characteristics of one generation in one global region can be absent on natives of other geographical regions, or can show up, some years later.

As stated, according to [4], different authors define different limits for the initial and the ending year of each generation. This is natural since there is no exact date when events impact human behavior. We will summarize generations' definitions which are relevant to our study.

1) Baby boomers or Boomers

According to [4], most sources identify baby boomers as people born between 1943 and 1965. They also highlight that the U.S. Census Bureau defines baby boomers as individuals born between 1946 and 1964 [4].

Baby boomers were raised to respect authority figures, but as they witnessed their antecessors, learned not to "trust anyone over 30" [10]. Protesting against power characterized their formative years. They grew up in an era of "prosperity and optimism and bolstered by the sense that they are a special generation capable of changing the world, have equated work with self-worth, contribution and personal fulfillment" [11]. Baby boomers have been characterized as individuals who believe that hard work and sacrifice are the price to pay for success [4].

2) Generation X or X-ers

In the case of the generation X, [4] states that the U.S. Census Bureau defined this segment of the population as consisting of individuals born between 1968 and 1979. However, the upper limit of Generation X in some cases has been as high as 1982, while the lower limit has been as low as 1963 [10].

Members of Generation X grew up in a period of financial, familial and societal insecurity. They grew up with a stagnant job market, corporate downsizing, and limited wage mobility. They are the first individuals predicted to earn less than their parents did [4]. They have grown up in homes where both parents work. They aspire more than previous generations to achieve a balance between work and life [12]. They are not overly loyal to their employers although they have strong feelings of loyalty towards their family and friends [10]. They value continuous learning and skill development [13].

3) Generation Y or Millenials

According to [4], the lower limit for Generation Y may be as low as 1978, while the upper limit may be as high as 2002, depending on the source. However, the definition of this generation presents high heterogeneity amongst sources.

Members of generation Y, or the millennials, have been shaped by dramatic technological advances [4]. One of the most frequently reported characteristics of this generation is their comfort with technology [14]. They value team work and collective action [15], and are adaptable to change [12]. Furthermore, they seek flexibility [16], are independent, desire a more balanced life [17], and are the most highly educated generation. They have been characterized as demanding [16] and as the most confident generation [18].

C. Studies about the Costa Rican ICT work market

The evolution of professional career of people graduated on Computer Science or Informatics in Costa Rica has been studied very shortly. In [1] emphasis is set on the identification of variables related to human resources which are important for the information and communication technology (ICT) sector growth. This study describes industry needs in a context of qualified staff shortage and government policies that should support the industry, but does not analyze the professional career of people graduated on Computer Science.

In [19], authors present the state of the software industry in Costa Rica in 2008. The software industry is not the only one in which graduates on Computer Science work, but it absorbs a high percentage of graduates on this field. Therefore, we think this study can contribute to understand some aspects which

could affect the professional career of people who dedicate to design and develop software, such as:

- There is staff shortage in the field of software development.
- 73% of the companies are micro or small companies. This can represent a constraint for professional growth because such companies offer few career development possibilities.
- 74% of people working in the software industry do not speak English fluently.
- 77% of the companies invest less than $10000 per year on employee training.
- Reaching a master degree makes it easier finding a job.
- Employers prefer hiring professionals graduated from public universities.
- The number of graduates on Computer Science has dramatically increased since 1997 due to the high number of students in private universities.
- In average, the software industry dedicates 12% of its budget to research and development. It is financed with own resources, due to the lack of risk capital in the country.

In [20], the authors update results obtained in [19]. This study shows the evolution of the Costa Rican software sector from 2008 to 2013. Some aspects that could affect the professional career of people who dedicate to design and develop software presented in this study are:

- The number of registered companies dedicated to software development grew from 109 in 2008 to 127 in 2013. However, only 34 companies (27%) survived and the rest (73%) were created during this period. This means there is a great mortality which can create job instability to professionals graduated on Computer Science.
- The size of companies of micro and large companies has grown, but the number of small and medium companies has decreased.
- 95% of company owners are men and 68% of these owners studied Computer Science.
- The software development field is dominated by men.
- The number of graduates on Computer Science between 20 and 29 years old has increased from 8.6 for each one thousand inhabitants in 2006 to 13.1 in 2011.
- It is difficult for the software industry to find banking options for financing innovation.

Some of these conditions define the opportunities and challenges that professionals in Computer Science face.

In [3], authors characterize the professional development model of men and women who studied Computer Sciences or Informatics in Costa Rica, in terms of types of work with which they begin their professional career and in which they report are currently working. The main finding of this work is that male and female professional evolutions have similar behaviors. However, differences among generations were not determined.

Most literature reviewed is mainly centered in the situation of the industry, but it does not deepen in the professional career of graduates on Computer Science. Even more, there is no gender study showing neither women's situation nor generational differences. Results presented on this paper will contribute to increase the knowledge about female Computer Science graduates in Costa Rica.

III. METHODOLOGY

The goal of our analysis was to identify how the professional career of women from different generations has changed in Costa Rica. In order to understand concepts related to professional career, the first step we followed was a literature review. Based on it, we built a questionnaire and evaluated its legibility and precision by making some researchers of the Research Center on TIC of the University of Costa Rica respond to it and give us feedback.

We used Lime Survey to implement the questionnaire in order to distribute it digitally and reach as much people as possible. We contacted the Costa Rican Association of Computer Science Professionals to be able to use its contact channels as distribution means. We sent the questionnaire to professors of other universities and ask them to distribute it among their graduated students in order to access non associated professionals. We also used our personal social networks and e-mail contacts for reaching more possible participants.

Answering the questionnaire was volunteer and anonymous. Since it was impossible to know previously how many people would respond, we decided up front that the questionnaire would be available on line until we reached 500 answers. Finally, we received 611 answers from October 2015 till January 2016. Female participants, whose results are analyzed on this paper, were 166 (27.2%). We consider it is a large sample size taking into account that Costa Rica is a small country and few women study Computer Science. Based on the literature review, female participants were divided in four groups: young millennials (20-29 years old), mature millennials (30-35 years old), generation X (36-50 years old), and baby boomers (51-62 years old).

Questions asked in the questionnaire were:

- Did you get a bachelor degree on Computer Science?
- Sex / Age
- Graduation year and university
- Did you get a postgraduate degree (e.g., Masters, Ph.D.)? Why?
- Highest degree obtained and degree field (Computer Science, Business Administration or other)
- Have you worked in the field of Computer Science?

- If you have worked in the field of Computer Science, have you ever left the labor market? Why?
- Number of years you have been working
- Number of employers you have worked for
- Industrial sector of your first job
- Role you played on the first working place
- Industrial sector of your current job
- Role you play on your current working place
- If you do not work as professor, have you ever worked as professor as a second job? Yes/No? Why?
- Obstacles you have faced during the development of your professional career.
- Reasons that have guided decisions related to your professional career development
- Which is your contribution to the society?
- Do you partially or totally own a company?
- If you own a company, was it a good decision? Which is the contribution of your company to the society?
- With your current experience, if you had to choose a field of study, would you choose Computer Science again?
- Degree of satisfaction with you professional career

IV. RESULTS

A. Demographic Data

The questionnaire was answered by 166 women graduated on Computer Science. Average age of participants is 36. Ages range from 22 to 62 years old. Only 161 of the 166 participant women developed a professional career on Computer Science. Most of the questions were answered only by these 161 women, who, according to their age, were classified in four generation groups: **Baby boomers** (51- 62 years old): 23 participants, **generation X** (36 – 50 years old): 47 participants, **mature millennials** (30 – 35 years old): 50 participants, **young millennials** (20 to 29 years old): 41 participants.

TABLE I. STYLES REASONS GUIDING ELECTIONS OF PROFESSIONAL CAREER. PERCENTAGE IS RELATIVE TO THE NUMBER OF WOMEN IN EACH GENERATION. RESPONDENTS WERE ALLOWED TO SELECT MORE THAN ONE CATEGORY, THUS PERCENTAGES DO NOT ADD TO 100%.

Reason guiding professional career decisions	Generations			
	Baby boomers	***Gen X***	***Mature Millennials***	***Young Millenials***
Opportunities of professional growth	34.8%	46.8%	48.0%	65.9%
Income	34.8%	34.0%	52.0%	63.4%
Employment stability	39.1%	51.1%	44.0%	34.1%

B. Professional Career Evolution

The professional career of women in Computer Science is determined by their own decisions, goals, and skills and by opportunities and obstacles in the labor market. The three main reasons that participants reported as guiding their elections of professional career are:

- Opportunities of professional growth (50.31%)
- Income (47.20%)
- Employment stability (42.86%)

Reasons such as having a flexible schedule, retribution to the society of part of what they have received from it, balance of working and family life, study possibilities (time and financial aid from the employer), travel possibilities, and freedom to decide what they want to do within their working framework are not reported as important by participants.

Since participants have worked from one to 42 years, it is possible that their answer to which reasons guide their decisions of those who have been longer in the labor market and have changed employer or role several times is influenced by the last times they have shifted. Table 1 shows reasons that guide their elections of professional career by generation. Young millennials are the generation more interested in finding opportunities of professional growth and in increasing their income. This generation is less interested in employment stability. This is understandable since they are very young and are familiarized with current technologies, which makes it easy for them to find a new job. Mature millennials report income as the most frequent reason guiding their decisions. This generation is still young and is updated in technology but they start to show higher interest on employment stability. Generation X is guided by employment stability and opportunities of professional growth. This is a generation of women which may face difficulties finding a new job because the fast rhythm of technology change makes it harder for them to keep updated in new tools. Baby boomers are not particularly guided by any of the three reported reasons. Employment stability is slightly higher but not significantly.

TABLE II. OBSTACLES REPORTED BY PARTICIPANTS. PERCENTAGE IS RELATIVE TO THE NUMBER OF WOMEN IN EACH GENERATION

Obstacle	Generations			
	Baby boomers	***Gen X***	***Mature Millennials***	***Young Millenials***
Lack of training opportunities	8.7%	31.9%	22.0%	34.1%
Lack of acknowledgement of my skills from my superiors	17.4%	23.4%	26.0%	22.0%
My inability to communicate in other languages	13.0%	19.1%	26.0%	19.5%
Discrimination due to my gender	8.7%	25.5%	26.0%	7.3%
Very small companies that offer no career development possibilities	0.0%	10.6%	20.0%	24.4%

Table 2 shows the obstacles in the professional career development more frequently reported by participants. In general, baby boomers report the lowest rate of obstacles. It is very likely that this generation has reached their personal and professional goals and when they are asked about obstacles, they have not faced any for a long time. One of each four women between 30 and 50 years old (mature millennials and generation X) reports that they have faced discrimination due to their gender. Young millennials and baby boomers do not seem to be very affected by this reason. Small companies that do not offer career development possibilities affects more young and mature millennials. X-ers and mature millennials are the generations more frequently reporting favoritism toward other people as an obstacle.

For baby boomers, lack of acknowledgement of skills from superiors seems to be the most present concern. On the other hand, lack of training opportunities is the obstacle most frequently reported by both Generation X and Young millennials. Mature millennials seem to be facing their professional life confronting more obstacles.

On the following sections we try to characterize the evolution of the professional career of the participants.

C. Sector Evolution

Women in the baby boomers generation started working between 1975 and 1985, which means they started working in organizations using mainframes. Generation X women started working between 1986 and 1999, when microcomputers had invaded the Costa Rican industry. Mature millennials started working between 2000 and 2006, when organizations had already found out that Internet was a valuable tool. Finally, young millennials started working between 2007 and 2015, a period in which mobile applications gained importance. This evolution in the computer market is visible in the evolution of industrial sectors professional women have worked on.

Figures 1, 2, 3 and 4 show the evolution of industrial sectors in which professional women from the four generations work. Figures include information of both women who have changed employer at least once and those who have not. The left axis shows the first sector in which women worked, and the right axis shows the current sector.

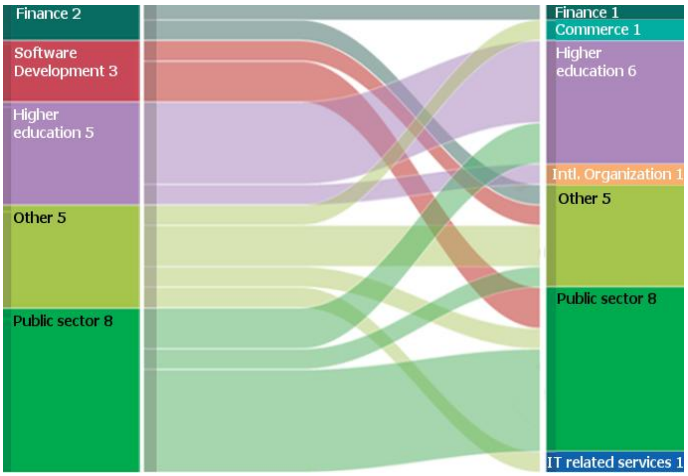

Fig. 1. Sector evolution of baby boomers.

Baby boomers (Figure 1) started working in the public (34.8%), higher education (21.7%), software development (13%), and finance (8.7%) sectors. The public sector (central government and related institutions) and public universities and banks were the first adopting computers in Costa Rica. These organizations were the only ones which could afford the cost of mainframes. Nine out of 23 baby boomers (47.8%) shifted to other sectors during their working lives, but they have mostly stayed in the same sectors they started working in. Currently, the public sector is still the most frequently reported (34.8%), followed by higher education (26.1%). These two sectors offer employment stability, one of the three main reasons that participants report as guiding their professional career decisions. None of the women reports to be currently working in the software development sector.

With the introduction of microcomputers, more organizations were able to invest on computers. This situation promoted the creation of a private software development sector, which has gradually become the most important entrance sector for professional women, as seen on figures 2, 3, and 4.

Figure 2, corresponding to X-ers, shows a wider variety of entrance sectors than Figure 1. Commerce, international organizations, education (primary and high school), and services related to technology emerged as new entrance sectors. The software development sector (36.2%) is the most frequently reported entrance sector by the generation X women, followed by the public sector (31.9%). Twenty six out of forty seven X-ers participants (55.3%) shifted to another sector. It is noticeable that the public sector (second in importance as entrance sector) has become the most frequently reported current sector (53.2%).

Once again, it seems women are looking for job stability. The public sector fed with professionals who started working in the software development sector. Only one of the seventeen women who started working in the software development sector still remains in it. This sector is reported only by 6.47% of participants as their current one. All women who started working in education moved to other sectors, very likely looking for higher income.

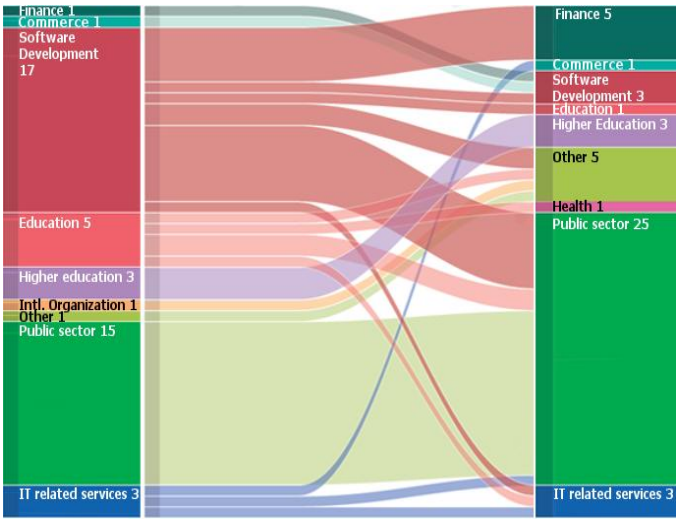

Fig. 2. Sector evolution of X-ers

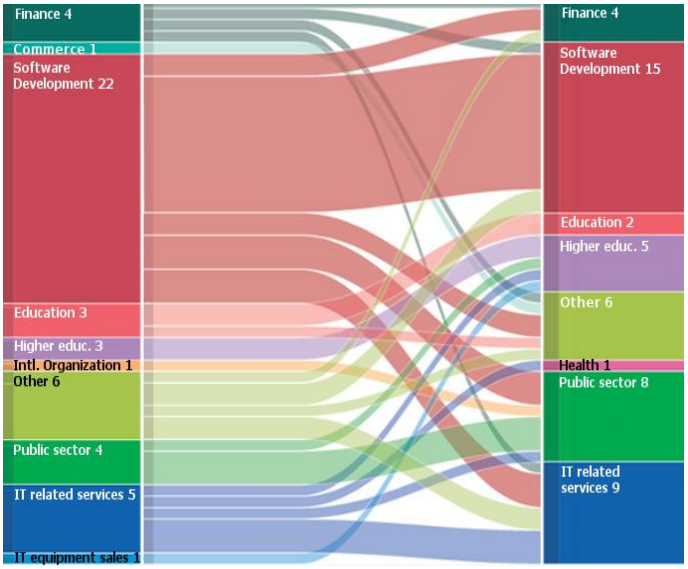

Fig. 3. Sector evolution of mature millennials

The most important entrance sector for mature millennials (Figure 3) is software development (44%), followed by services related to technology (10%), public sector (8%), and finance (8%). A great dynamism is evident. Twenty six women out of fifty women (52%) in this generation have already shifted to another sector. Regarding the current sector, software development (30%) is the most frequently reported, but services related to technology sector (18%), public sector (16%), and higher education (10%) have almost doubled.

As shown on Figure 4, most young millennials (68.3%) reported software development as their entrance and current sectors, followed by services related to technology (9.8%) and public sector (7.3%). Despite women in this group started working few years ago, 26.8% of them already shifted to other sectors. Software development (65.9%) is the more frequently current sector reported.

It is noticeable that the public sector lost importance as entrance sector for millennials. However, mature millennials have already started to shift to this sector.

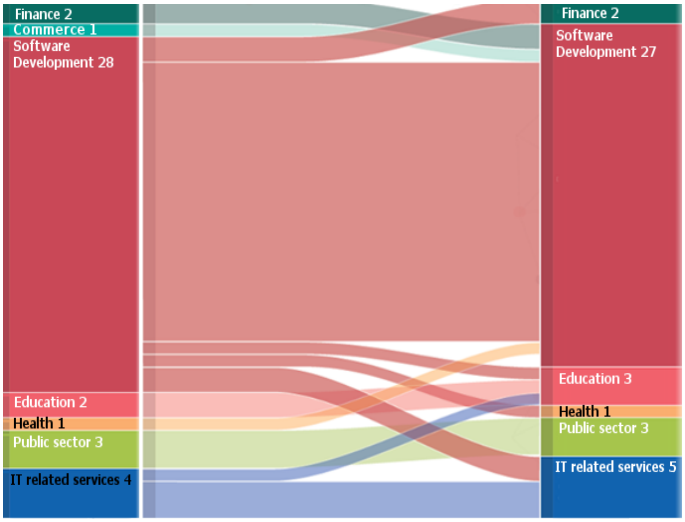

Fig. 4. Sector evolution of young millennials

TABLE III. SECTORS GENERATING LESS EMIGRATION

Generation	Sectors with less emigration and percentage of emigration
Baby boomers	Higher education – 20%
	Public sector – 37.5%
Generation X	Higher education – 0%
	Public sector – 0%
Mature millennials	Higher education – 0%
	Public sector – 25%
Young millennials	Education – 0%
	Public sector – 0%

Despite the high percentage of professionals who have moved to another sector, some sectors generate less emigration. Public sector is common to the four generations, as seen on Table 3. The other sector is higher education for baby boomers and mature millennials and education for X-ers and young millennials. These sectors are characterized for offering employment stability. Baby boomers, who have worked longer, have higher rates of emigration.

D. Role Evolution

Figures 5, 6, 7, and 8 show the evolution of roles played by women of four generations: baby boomers, generation X, mature millennials, and young millennials, respectively. Figures include information of both women who have changed role at least once and those who have not. The left axis shows the first role played in the first working place by professional women, and the right axis shows the current role.

The role of programmer is the most frequently reported as first role by young millennials (58.5%), mature millennials (44%), and baby boomers (34.8%). Analyst/software engineer is the role most frequently reported by X-ers (34%), followed by programmer (25.5%). Younger generations (mature and young millennials) reported programmer as first role more frequently than older generations. This is congruent with what is shown on figures 1, 2, 3, and 4, in which the software development sector gradually becomes more important.

The role analyst/software engineer is the second most frequently reported as first role by young millennials (17.1%), mature millennials (24%), and baby boomers (17.4%). Young millennials are the only ones who do not report the role professor as first role. Some millennials reported the role quality assurance as first reole. This fact reflects a change in the practice of software engineering in Costa Rica. In the late nineties of the twentieth century, software development companies started to introduce the practice of quality assurance in the process.

As expected, few women from all generations reported managerial roles (director/chief of administrative unit, manager, and project manager) as first role. These roles require the development of skills which are not common in recently graduated professionals. Figures 5, 6, 7 and 8 show a high dynamism in role changes.

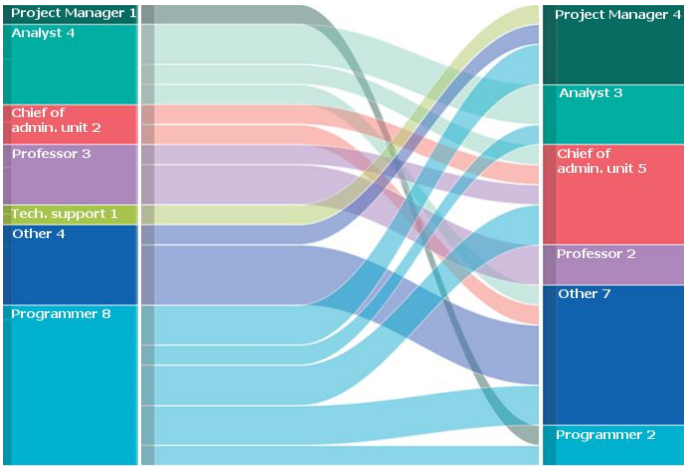

Fig. 5. Role evolution of baby boomers

The role that gets significantly smaller for all generations is programmer. In fact, only 23% of female programmers are older than 30 years old. This shows that the role of programmer is an entrance role. The role analyst/software engineering gains importance as current role for young and mature millennials. For older generations, this role is still one of the more frequently current roles but it loses importance.

Managerial roles (director/chief of administrative unit and manager) gain participation in older generations. These roles require developing skills that are not present in younger people. "Project manager" is not mentioned by baby boomers as current role (Figure 5), but it is by generation X and mature millennials, as shown on figures 6 and 7, respectively. This role requires knowledge and training generally not taught at a bachelor degree on Computer Science.

Quality assurance is a role not played by baby boomers, but the other three generations reported this role as current job. This is a technical job which requires some degree of specialization and additional training. The topic of quality assurance started gaining importance in Costa Rica during the last five years of the twentieth century. This can explain why baby boomers did not introduce in this role.

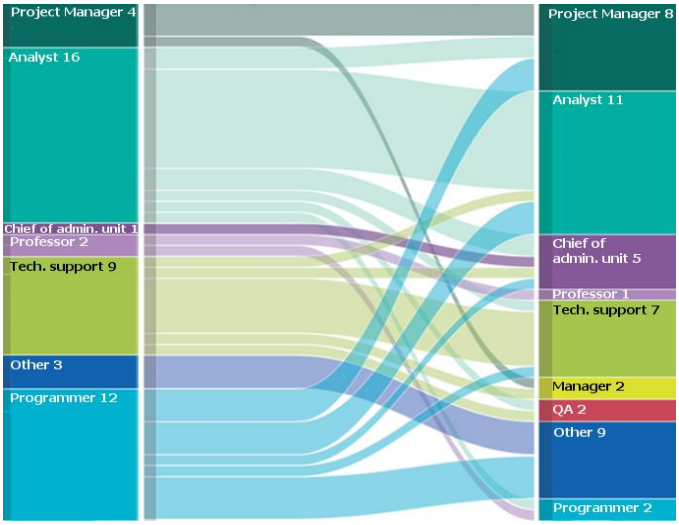

Fig. 6. Role evolution of X-ers

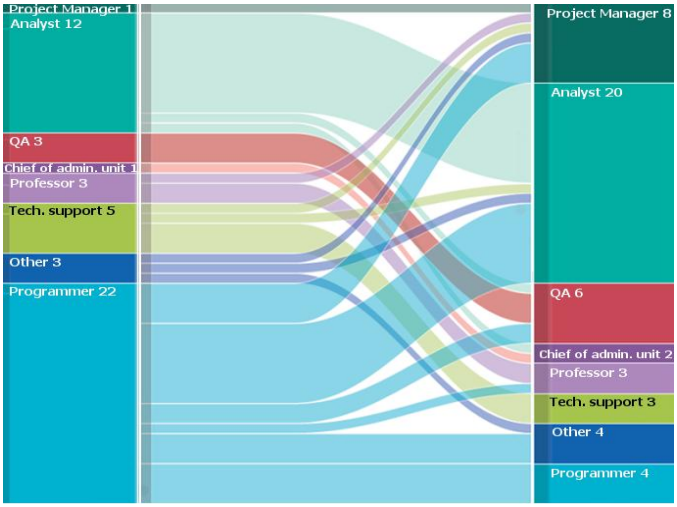

Fig. 7. Role evolution of mature millennials

Young millennials have moved to technical roles which they also reported as first roles (Figure 8). Analyst/software engineering and quality assurance are the current roles that have gained more importance for this generation. The other three generations show two facts:

- Baby boomers (Figure 5), X-ers (Figure 6) and mature millennials (Figure 7) show great dynamism. More than 50% of women in these three generations have shifted from their entrance role to a different role.
- Women have shifted to roles that were not among the first roles they reported. The role Other becomes more frequent as generations get older. Women start playing less technical or more specialized roles. Roles included in the Other category include:
  - Software architecture and information technology auditor for baby boomers
  - Data base manager, information technology auditor and information technology strategy for generation X
  - Business analyst and software architecture for mature millennials

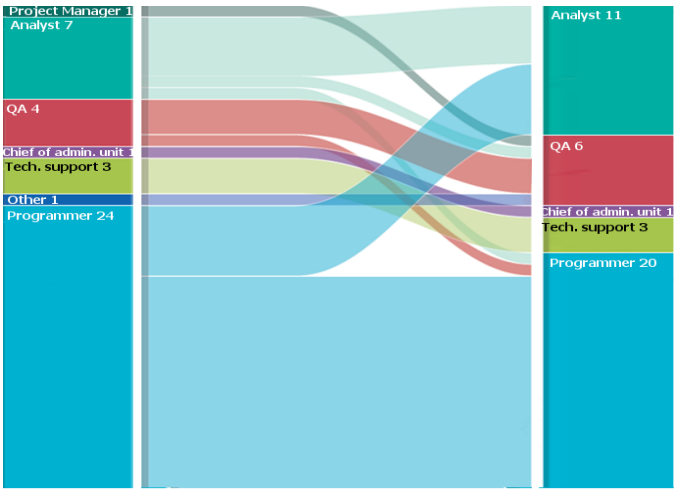

Fig. 8. Role evolution of young millennials

TABLE IV. SECTORS GENERATING LESS EMIGRATION

Generation	Sectors with less emigration and percentage of emigration
Baby boomers	Professor – 33.3%
Generation X	Director/chief of administrative unit – 0%
	Project manager – 25%
Mature millennials	Director/chief of administrative unit – 0%
	Quality assurance – 0%
	Project manager – 20%
Young millennials	Director/chief of administrative unit – 0%
	Technical support – 0%

Despite the high percentage of professionals who have moved to another role, some roles generate less emigration (see Table 4). Baby boomers, who have worked longer, have higher rates of emigration. The role with the lowest emigration rate for this generation is professor. The role director/chief of administrative unit is common to the other three generations. Those women who started working in this role remain on it. The other roles generating less emigration include both technical and managerial roles.

E. Professional Women on Computer Science and Teaching

Availability of Computer Science teachers is important in order to ensure that high schools and universities can achieve their goal of educating people in this field. Teaching is a professional career that not many of the participants have chosen. Only six women work as teachers. Among the other 155, 48 (31%) have worked as teachers as a second job. The motivations they reported for teaching are:

- I like teaching (72.92% of 48 women).
- In order to help other people to achieve their ownpersonal growth (60.42% of 48 women).
- In order to keep myself updated in my field (52.08% of 48 women).

On the other hand, 47.66% of the 107 who have never worked as teachers reported that they have not for lack of time. When analyzing the generations the 48 women who have worked as teacher belong to, we found the following distribution:

- 4 women between 22 and 29 years old (9.7% of young millennials)
- 10 women between 30 and 35 years old (20% of mature millennials)
- 21 women between 36 and 50 years old (44.7% of generation X)
- 13 women between 51 and 62 years old (56.5% of baby boomers)

Noticeably, women belonging to the older generations show a higher percentage of participation in teaching. There are several reasons that can explain this fact. Young women (millennials) may still be interested in further studies, which would not leave them time for teaching. They may not feel ready for this duty. Baby boomers may have more free time due to being free of family responsibilities.

F. Entrepreneur Women

Only eight (5%) women participating in this research own, partially or totally, a company. All of them think it was a good decision to be entrepreneurs. These women are between 27 and 49 years old. Motivations of women for shifting from employees to entrepreneurs are professional growth (50%), independence (25%), and flexibility (25%).

Seven companies are very small (one to seven employees) and one has 40 employees. Half of the companies are dedicated to software development and one is dedicated to services related to information technology. The other three companies are not related to computers.

Entrepreneurs reported that the contributions of their companies to the society are a positive impact in people life quality (62.50%) and the development of innovative products (37.5%).

A relatively very low percentage of professional women have decided to change an employee career for an entrepreneurial one. This is an aspect that requires more study in order to determine what motivates this decision and why only few women take this professional path.

G. Degree of Satisfaction with the Professional Career

To the question of how you feel respect to your professional career, 62.7% of women answered they feel very satisfied and 31.1% some satisfied. By generation, percentages are as follows:

- Baby boomers: 69.6% very satisfied and 26% some satisfied
- Generation X: 63.8% very satisfied and 27.7% some satisfied
- Mature millennials: 56% very satisfied and 34% some satisfied
- Young millennials: 65.9% very satisfied and 34.1% some satisfied

We did not ask why they reach the degree of satisfaction they answer, but we think it may be related to the ways they think they contribute to the society:

- Products and services which improve people life quality (49%)
- Access to information (39.1%)
- Better services provided to citizens by public institutions (36.7%)
- Generation of new knowledge and technologies useful for the society (26.7%)

Nature of these ways of contribution is social. Most women feel they do something useful for the society. This may contribute to the degree of satisfaction they report. Table 5 shows ways of contribution to society frequently reported by participants.

TABLE V. CONTRIBUTION TO SOCIETY BY GENERATION

Contribution	Generations			
	Baby boomers	Gen X	Mature millennials	Young millennials
Products and services which improve people life quality	43.5%	66.0%	52.0%	58.5%
Access to information	34.8%	51.1%	32.0%	36.6%
Better services provided to citizens by public institutions	52.2%	55.3%	28.0%	17.1%
Generation of new knowledge and technologies useful for the society	34.8%	23.4%	26.0%	26.7%

As seen on Table 5, generation X reaches the highest percentages in three of the contribution ways. It means they value their impact on society very high. The contribution "better services provided to citizens by public institutions" gets more importance as generations are older, which is consistent with the fact that women looking for employment stability move to the public sector as they become more mature. Only one woman out of four reports that she generates new knowledge and technologies useful for the society in a field of creation of technological tools. This may mean that the Costa Rican industry does not offer many opportunities to work on research and development.

To the question whether they would choose to study Computer Science based on their current experience, 77% of women answered yes. When observed by generation, we got the following percentages:

- Baby boomers: 52.2%
- Generation X: 74.5%
- Mature millennials: 80.0%
- Young millennials: 90.2%

It is noticeable that younger generations are more willing to choose to study Computer Science based on their current experience again. If more than 90% of baby boomers and X-ers are very satisfied or some satisfied with their professional career, why are so many of them unwilling to choose to study Computer Science? Women in older generations know themselves better and could have discovered other study fields that are also interesting to them. Additionally, keeping updated in Computer Science is hard, due to the rapid rhythm of technology change. Therefore, baby boomers and generation X may be exhausted. They may also have found obstacles that they think would not exist in other fields.

V. CONCLUSIONS

Results reflect significant differences on the female professional career evolution among different generations. For example, reasons guiding their elections of professional career vary between generations. Older generations give more importance to employment stability, whereas younger generations guide their decisions mostly by opportunities of professional development and income.

Moreover, representatives of different generations face different challenges and express different concerns. For baby boomers, lack of acknowledgement of skills from superiors seems to be the most present concern. On the other hand, lack of training opportunities is the obstacle most frequently reported by both Generation X and Young millennials. Mature millennials seem to be facing their professional life confronting more heterogeneous obstacles than the previous generations.

Evolution in ICT is visible in the evolution of industrial sectors professional women have worked on. Women in the baby boomers generation started working in organizations using mainframes, X-er women started working when microcomputers had invaded the Costa Rican industry, mature millennials started working when organizations had already found out that Internet was a valuable tool, and finally, young millennials started working when mobile applications gained importance. As a result, the public sector and the higher education sector were critical for ICT in the early years, and baby boomers started working, and remain working, mainly in these sectors. The software development sector became very relevant for the next generations.

Emigration from other sectors to the public sector can be highlighted. Employment stability and limited working hours can be some of the motives to emigrate. Emigration to other industrial sectors may be due to opportunities for professional growth or better income offers.

Role differences also exist among generations. The role of programmer is the most frequently reported as first role by young millennials, mature millennials, and baby boomers. Analyst/software engineer is the role most frequently reported by X-ers, followed by programmer. Younger generations (mature and young millennials) reported programmer as first role more frequently than older generations. However, this role gets significantly smaller with time for all generations. In fact, only 23% of female programmers are older than 30 years old. This shows that the role of programmer is an entrance role. The role analyst/software engineering gains importance as current role for young and mature millennials. For older generations, this role is still one of the more frequently current roles but it loses importance. Managerial roles (director/chief of administrative unit and manager) gain participation in older generations.

Older generations show a higher participation in teaching. Their reasons for deciding to work as teachers are not related to economic factors but to personal satisfaction and social reasons.

Entrepreneurship among women, independently of the generation they belong to, is still low, which is consistent with the literature review. It is not clear why this happens, but it may be that becoming an entrepreneur is not consistent with the reasons guiding professional career decisions.

It is very interesting to highlight that most women, independent of their generation, are very satisfied (62.7%) or satisfied (31.1%) with their professional career. This is an important conclusion that can be used to attract more women to the ICT field.

VI. ACKNOWLEDGEMENTS

We thank the 166 women who answered our questionnaire.

REFERENCES

[1] C. Pinto, R. Herrera, F. Mata, R. Matarrita, I. Salas y E. Jara. *Formación de capital humano en el sector de TIC de Costa Rica*. Centro Internacional de Investigaciones para el Desarrollo, México: FLACSO México, 2009

[2] I. Gutiérrez, L. Kikut, G. Navarro, C. Azofeifa y N. Rodríguez Ramos. *Seguimiento de la condición laboral de las personas graduadas 2008-2010 de las universidades costarricenses*. Consejo Nacional de Rectores, San José, Costa Rica, 2015

[3] M. Calderón-Campos, G. López, and G. Marín-Raventós, "Evolución en la carrera profesional de los graduados en Computación en Costa Rica: Un análisis de género," *Proc. Latin American Women in Computing Conference (LAWCC'16)*, October 2016.

[4] A. Tolbize. *Generational differences in the workplace*. Minnesota: Research and Training Center on Community Living, University of Minnesota, 2008.

[5] M.S. Jiménez. *Tendencias y hallazgos en los estudios de trayectoria: una opción metodológica para clasificar el desarrollo laboral*. Revista Electrónica de Investigación Educativa, Vol. 11, n. 1, 2009, http://redie.uabc.mx/vol11no1/contenido-jimenez.html

[6] 6. M.R. Vargas. *Trayectoria profesional de los ingenieros en la industria maquiladora electrónica*: *El caso de Sanyo Video Componentes*. Revista Electrónica de Investigación Educativa, Vol. 2, n. 2, 2000, http://redie.uabc.mx/redie/article/view/22/40

[7] G. León, A. Bernardos, V. Burillo, J.C. Dueñas, C. Matías y F. Sáez, *Evolución de los perfiles profesionales TIC en la Sociedad del Conocimiento*. Spain: Asociación Nacional de Industrias Electrónicas y Telecomunicaciones. http://ametic.es/sites/default/files//9527dd01.pd

[8] J.L. Quesenberry and E.M. Trauth, "What Do Women Want?: An Investigation of Career Anchors among Women in the IT Workforce," *Proc. ACM SIGMIS Computers and People Research (SIGMIS - CPR'07)*, pp. 122–127, April 2007.

[9] D. Joseph, S. Ang, and S. Slaughter, "Identifying the Prototypical Career Paths of IT Professionals: A Sequence and Cluster Analysis," *Proc. ACM SIGMIS Computers and People Research* (SIGMIS-CPR'05), pp. 94–96, April 2005

[10] H. Karp, C. Fuller, and D. Sirias, *Bridging the boomer Xer gap. Creating authentic teams for high performance at work.* Palo Alto, CA: Davies-Black Publishing, 2002.

[11] S. M. Yang. and M.E. Guy, "GenXers versus boomers: Work motivators and management implications". *Public Performance & Management Review,* vol. 29, pp. 267–284, 2006.

[12] J. Jenkins, "Leading the four generations at work". Retrieved April 15, 2008, from http://www.amanet.org/movingahead/editorial.cfm?Ed=452, 2007

[13] *B.* Bova and M. Kroth, "Workplace learning and generation X," *Journal of Workplace Learning, vol. 13,no. 12, pp.* 57–65, 2001.

[14] D. Kersten, *Today's generations face new communication gaps.* Retrieved April 15, 2008, from http://www.usatoday.com/money/jobcenter/workplace/communications/2002, 2002.

[15] R. Zemke, C. Raines, and B. Filipczak, *Generations at work: Managing the clash of veterans, boomers, Xers, and nexters in your workplace.* New York: AMACOM, 1999.

[16] C.A. Martin, "From high maintenance to high productivity. What managers need to know about Generation Y," *Industrial and Commercial Training,* vol.37, pp. 39–44. 2002.

[17] S.M. Crampton and J.W. Hodge, "The supervisor and generational differences", *Proceedings of the Academy of Organizational Culture, Communications and Conflict,* vol. 11, pp. 19–22, 2006.

[18] A. Glass, "Understanding generational differences for competitive success," *Industrial and Commercial Training,* vol. 39, pp. 98–103, 2007.

[19] L. Brenes and V. Govaere, "La industria del software en Costa Rica," *Revista de Comercio Exterior*, vol. 58, no. 5, pp. 303–311, May 2008.

[20] L. Brenes, A.R. Baraya, M.C. Budden and *L. Bermúdez, "*Revisiting the Software Industry in Costa Rica: Achievements and Challenges," *Journal of Service Science*, vol. 8, no. 1, pp. 29–32, November 2015.